RIP version 1

Routing Protocols and Concepts – Chapter 5

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Version 4.0

Objectives

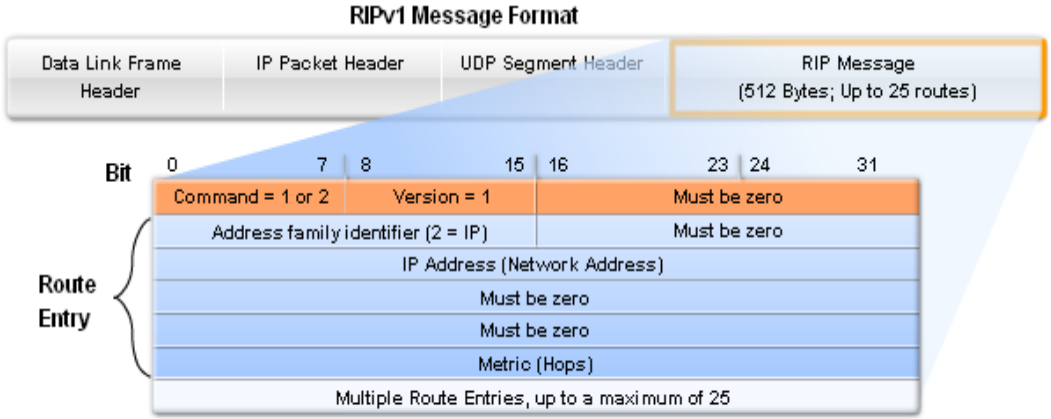
- Describe the functions, characteristics, and operation of the RIPv1 protocol.
- Configure a device for using RIPv1.
- Verify proper RIPv1 operation.
- Describe how RIPv1 performs automatic summarization.
- Configure, verify, and troubleshoot default routes propagated in a routed network implementing RIPv1.
- Use recommended techniques to solve problems related to RIPv1.

RIPv1

- RIP Characteristics
  - A classful, Distance Vector (DV) routing protocol
  - Metric = hop count
  - Routes with a hop count > 15 are unreachable
  - Updates are broadcast every 30 seconds

RIPv1

- RIP Message Format
- RIP header - divided into 3 fields
  - Command field
  - Version field
  - Must be zero
- Route Entry - composed of 3 fields
  - Address family identifier
  - IP address
  - Metric



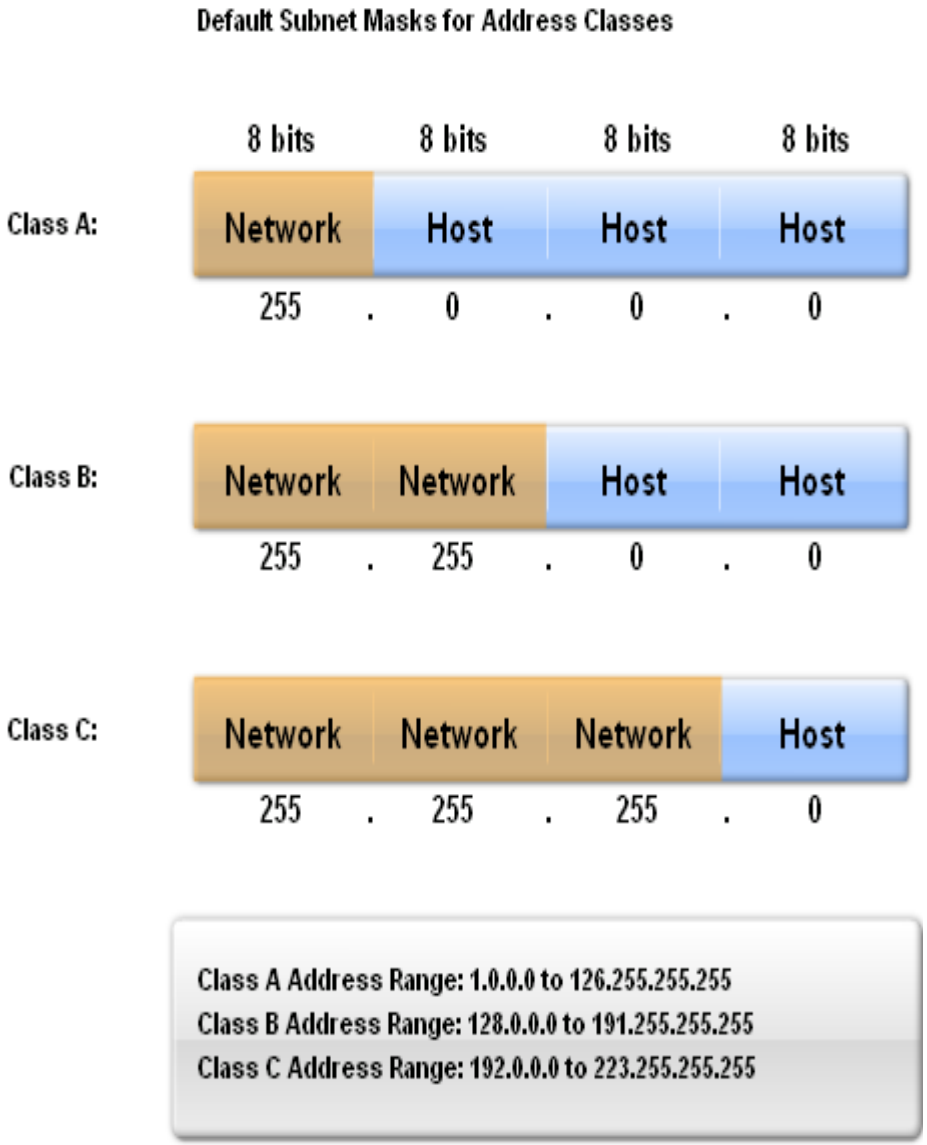
Command	1 for a Request or 2 for a Reply.
Version	1 for RIP v 1 or 2 for RIP v 2.
Address Family Identifier	2 for IP unless a Request is for the full routing table in which case, set to 0.
IP Address	The address of the destination route, which may be a network, subnet, or host address.
Metric	Hop count between 1 and 16. Sending router increases the metric before sending out message.

RIPv1

- RIP Operation
  - RIP uses 2 message types:
    - Request message
      - This is sent out on startup by each RIP enabled interface
      - Requests all RIP enabled neighbors to send routing table
    - Response message
      - Message sent to requesting router containing routing table

RIPv1

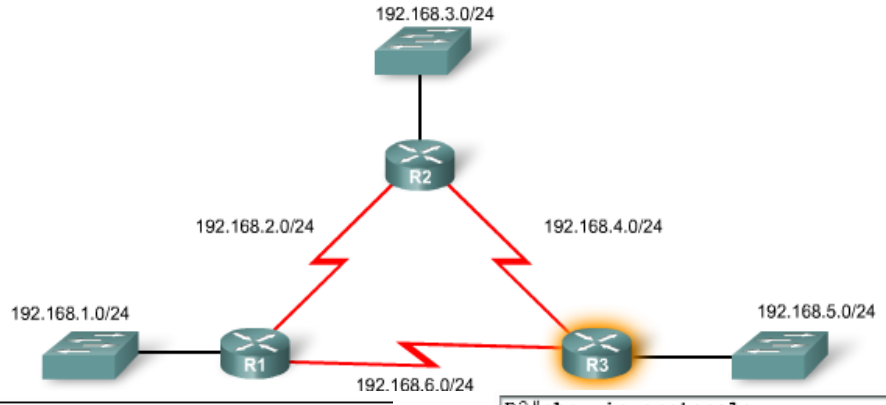
- IP addresses initially divided into classes
  - Class A
  - Class B
  - Class C
- RIP is a classful routing protocol
  - Does not send subnet masks in routing updates



RIPv1

- **Administrative Distance**
  - RIP's default administrative distance is 120

Verifying Administrative Distance



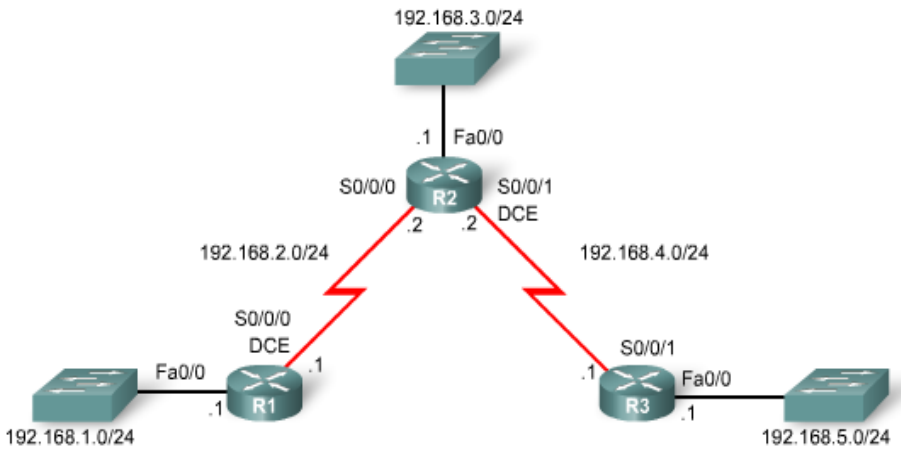

```
R3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

R    192.168.1.0/24 [120/1] via 192.168.6.2, 00:00:05, Serial0/0/0
R    192.168.2.0/24 [120/1] via 192.168.6.2, 00:00:05, Serial0/0/0
                    [120/1] via 192.168.4.2, 00:00:05, Serial0/0/1
R    192.168.3.0/24 [120/1] via 192.168.4.2, 00:00:05, Serial0/0/1
C    192.168.4.0/24 is directly connected, Serial0/0/1
C    192.168.5.0/24 is directly connected, FastEthernet0/0
C    192.168.6.0/24 is directly connected, Serial0/0/0
```

```
R3#show ip protocols
Routing Protocol is "rip"
  <output omitted>
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface              Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0        1     1 2
    Serial0/0/0            1     1 2
    Serial0/0/1            1     1 2
  Automatic network summarization is in effect
  Routing for Networks:
    192.168.4.0
    192.168.5.0
    192.168.6.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.6.2          120      00:00:10
    192.168.4.2          120      00:00:18
  Distance: (default is 120)
```

Basic RIPv1 Configuration

- **A typical topology suitable for use by RIPv1 includes:**
  - Three router set up
  - No PCs attached to LANs
  - Use of 5 different IP subnets

RIP Topology: Scenario A



Addressing Table: Scenario A

Device	Interface	IP Address	Subnet Mask
R1	Fa0/0	192.168.1.1	255.255.255.0
	S0/0/0	192.168.2.1	255.255.255.0
R2	Fa0/0	192.168.3.1	255.255.255.0
	S0/0/0	192.168.2.2	255.255.255.0
	S0/0/1	192.168.4.2	255.255.255.0
R3	Fa0/0	192.168.5.1	255.255.255.0
	S0/0/1	192.168.4.1	255.255.255.0

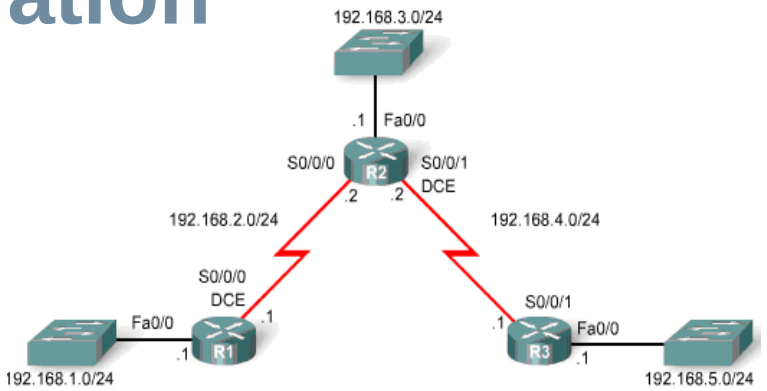
Basic RIPv1 Configuration

- Router RIP Command
  - To enable RIP enter:
    - *Router rip* at the global configuration prompt
    - Prompt will look like ***R1(config-router)#***

```
R1#conf t
Enter configuration commands, one per line. End with CTRL/Z.
R1(config)#router ?
  bgp         Border Gateway Protocol (BGP)
  egp         Exterior Gateway Protocol (EGP)
  eigrp       Enhanced Interior Gateway Protocol (EIRGP)
  igrp        Interior Gateway Routing Protocol (IGRP)
  isis        ISO IS-IS
  iso-igrp    IGRP for OSI networks
  mobile      Mobile routes
  odr         On Demand stub Routes
  ospf        Open Shortest Path First (OSPF)
  rip         Routing Information Protocol (RIP)

R1(config)#router rip
R1(config-router)#
```

Basic RIPv1 Configuration

- Specifying Networks
  - Use the ***network*** command to:
    - Enable RIP on all interfaces that belong to this network
    - Advertise this network in RIP updates sent to other routers every 30 seconds



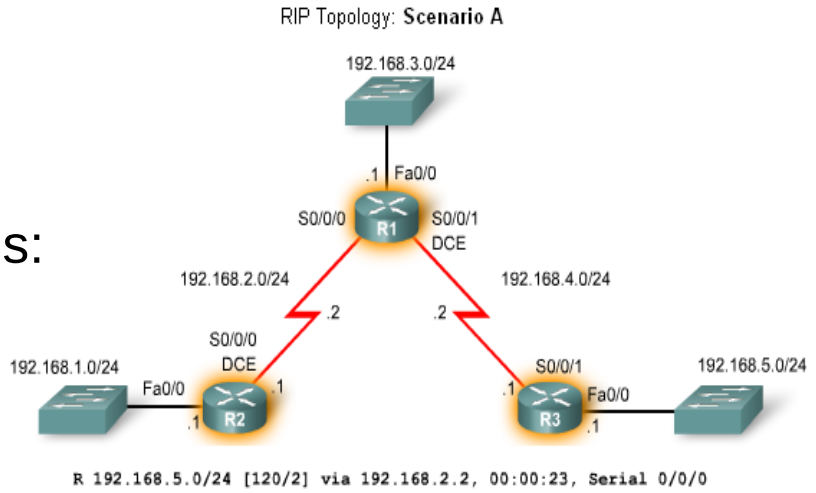

```
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 192.168.2.0
```

```
R2(config)#router rip
R2(config-router)#network 192.168.2.0
R2(config-router)#network 192.168.3.0
R2(config-router)#network 192.168.4.0
```

```
R3(config)#router rip
R3(config-router)#network 192.168.4.0
R3(config-router)#network 192.168.5.0
```

Verification and Troubleshooting

- Show ip Route
- To verify and troubleshoot routing
  - Use the following commands:
    - show ip route
    - show ip protocols
    - debug ip rip




```
R 192.168.5.0/24 [120/2] via 192.168.2.2, 00:00:23, Serial 0/0/0
```

Interpreting a RIP Route in the Routing Table

R	Identifies the source of the route as RIP.
192.168.5.0	Indicates the address of the remote network.
/24	The subnet mask used for this network
[120/2]	The administrative distance (120) and the metric (2 hops)
via 192.168.2.2	Specifies the address of the next-hop router (R2) to send traffic to for the remote network.
00:00:23	Specifies the amount of time since the route was updated (here, 23 seconds). Another update is due in 7 seconds.
Serial0/0/0	192.168.4.2

Verification and Troubleshooting

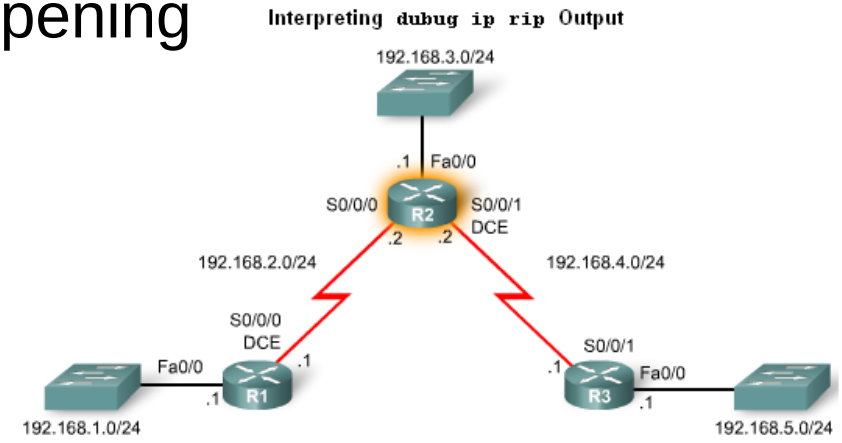
- *show ip protocols* command
  - Displays routing protocol configured on router

```
Incoming update filter list for all interfaces is not set
Redistributing: rip
Default version control: send version 1, receive any version
  Interface                Send  Recv  Triggered RIP  Key-chain
  FastEthernet0/0          1        1 2
  Serial0/0/0              1        1 2
  Serial0/0/1              1        1 2
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
  192.168.2.0
  192.168.3.0
  192.168.4.0
Routing Information Sources:
  Gateway         Distance      Last Update
  192.168.2.1           120         00:00:18
  192.168.4.1           120         00:00:22
Distance: (default is 120)
```

- Routing Information Sources are the RIP neighbors this router is currently receiving updates from.
- Includes next-hop IP address, the AD, and when the last update was received.
- Last line shows the AD for this router.

Verification and Troubleshooting

- **Debug ip rip** command
  - Used to display RIP routing updates as they are happening




```
R2#debug ip rip
RIP protocol debugging is on
RIP: received v1 update from 192.168.2.1 on Serial0/0/0
      192.168.1.0 in 1 hops
RIP: received v1 update from 192.168.4.1 on Serial0/0/1
      192.168.5.0 in 1 hops
RIP: sending  v1 update to 255.255.255.255 via FastEthernet0/0 (192.168.3.1)
RIP: build update entries
      network 192.168.1.0 metric 2
      network 192.168.2.0 metric 1
      network 192.168.4.0 metric 1
      network 192.168.5.0 metric 2
RIP: sending  v1 update to 255.255.255.255 via Serial0/0/1 (192.168.4.2)
RIP: build update entries
      network 192.168.1.0 metric 2
      network 192.168.2.0 metric 1
      network 192.168.3.0 metric 1
RIP: sending  v1 update to 255.255.255.255 via Serial0/0/0 (192.168.2.2)
RIP: build update entries
```

- R2 receives an update from R1 advertising the R1's directly connected LAN.
- R2 receives an update from R3 advertising the R3's directly connected LAN.
- R2 sends an update out Fa0/0 to all networks in the routing table except the network attached to Fa0/0.
- R2 sends an update out S0/0/1 to R3. Included in the update are R1's LAN, the WAN between R1 and R2, and R2's LAN.
- Note that split horizon is in effect. R2 does not advertise the R3 LAN back to R3.

Verification and Troubleshooting

- **Passive interface** command
  - Used to prevent a router from sending updates through an interface
  - Example:
    - Router(config-router)#passive-interface interface-type interface-number

Verification and Troubleshooting

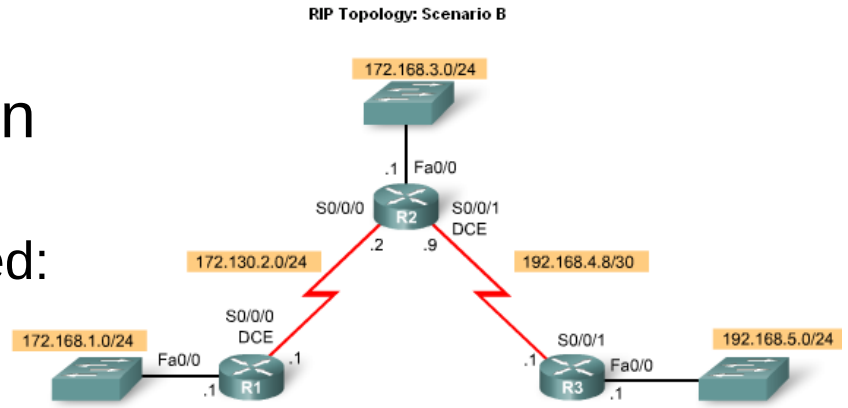
- **Passive interfaces**

```
R2(config)#router rip
R2(config-router)#passive-interface FastEthernet 0/0
R2(config-router)#end
R2#show ip protocols
Routing Protocol is "rip"
    Sending updates every 30 seconds, next due in 14 seconds
    Invalid after 180 seconds, hold down 180, flushed after 240
    Outgoing update filter list for all interfaces is
    Incoming update filter list for all interfaces is
    Redistributing: rip
    Default version control: send version 1, receive any version
      Interface              Send  Recv  Triggered RIP  Key-chain
      Serial0/0/0            1     1 2
      Serial0/0/1            1     1 2
    Automatic network summarization is in effect
    Routing for Networks:
      192.168.2.0
      192.168.3.0
      192.168.3.0
      192.168.4.0
    Passive Interface(s):
      FastEthernet0/0
    Routing Information Sources:
    Gateway         Distance      Last Update
      192.168.2.1           120      00:00:27
      192.168.4.1           120      00:00:23
Distance: (default is 120)
```

Notice FastEthernet 0/0 is no longer listed under "Default version contol:"
However, R2 is still routing for 192.168.3.0 and now lists FastEthernet under "Passive Interfaces:"

Automatic Summarization

- **Modified Topology**
- The original scenario has been modified such that:
  - Three classful networks are used:
    - 172.30.0.0/16
    - 192.168.4.0/24
    - 192.168.5.0/24
  - The 172.30.0.0/16 network is subnetted into three subnets:
    - 172.30.1.0/24
    - 172.30.2.0/24
    - 172.30.3.0/24
  - The following devices are part of the 172.30.0.0/16 classful network address:
    - All interfaces on R1
    - S0/0/0 and Fa0/0 on R2



RIP Topology: Scenario B

Subnet Mask	Subnet Mask	Subnet Mask	Subnet Mask
R1	Fa0/0	172.30.1.1	255.255.255.0
	S0/0/0	172.30.2.1	255.255.255.0
R2	Fa0/0	172.30.3.1	255.255.255.0
	S0/0/0	172.30.2.2	255.255.255.0
	S0/0/1	192.168.4.9	255.255.255.252
R3	Fa0/0	192.168.5.1	255.255.255.0
	S0/0/1	192.168.4.10	255.255.255.252

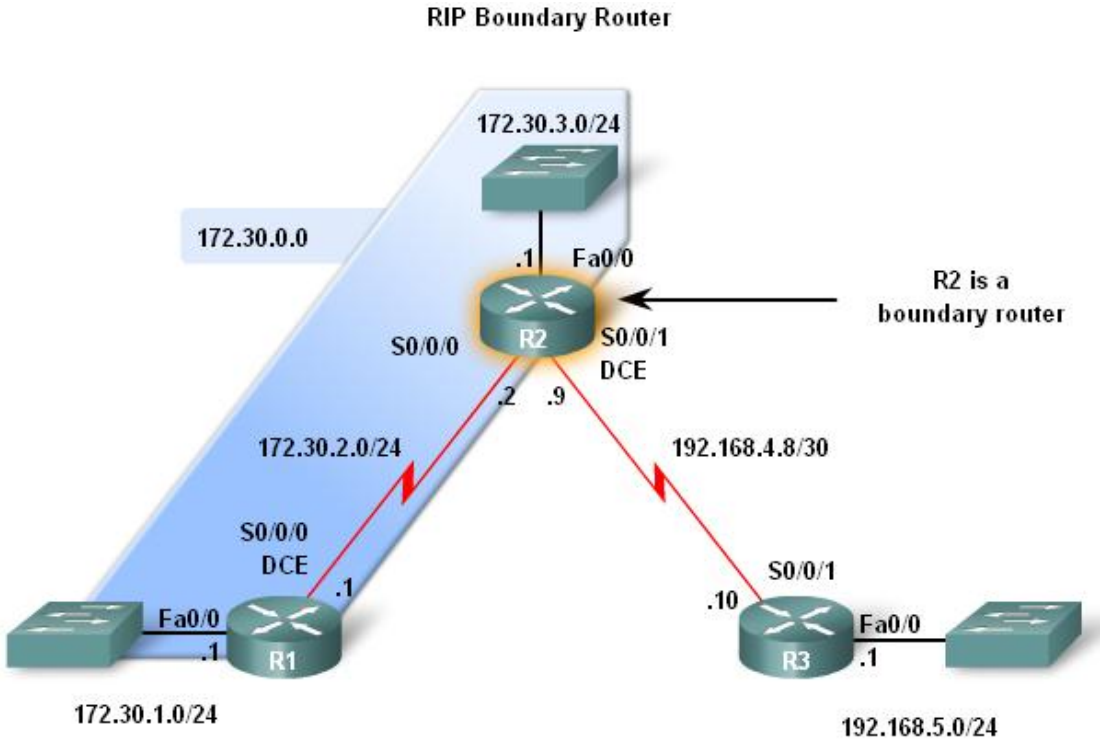
Automatic Summarization

- **Configuration Details**
  - To remove the RIP routing process use the following command
    - *No router rip*
  - To check the configuration use the following command
    - *Show run*

```
R2(config)#interface S0/0/0
R2(config-if)#ip address 172.30.2.2 255.255.255.0
R2(config-if)#interface fa0/0
R2(config-if)#ip address 172.30.3.1 255.255.255.0
R2(config-if)#interface S0/0/1
R2(config-if)#ip address 192.168.4.9 255.255.255.252
R2(config-if)#no router rip
R2(config)#router rip
R2(config-router)#network 172.30.0.0
R2(config-router)#netowrk 192.168.4.8
R2(config-router)#passive-interface FastEthernet 0/0
R2(config-router)#end
R2#show run
<output omitted>
!
router rip
 passive-interface FastEthernet0/0
```

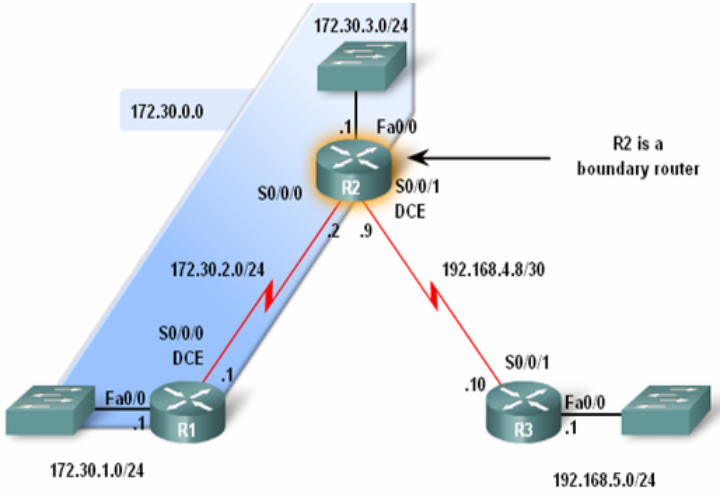
Automatic Summarization

- **Boundary Routers**
  - RIP automatically summarizes classful networks
  - Boundary routers summarize RIP subnets from one major network to another



Automatic Summarization

- **Processing RIP Updates**
- 2 rules govern RIPv1 updates:
  - If a routing update and the interface it's received on belong to the **same** network then
    - The subnet mask of the interface is applied to the network in the routing update
  - If a routing update and the interface it's received on belong to a **different** network then
    - The classful subnet mask of the network is applied to the network in the routing update




```
R2#debug ip rip
RIP protocol debugging is on
RIP: received v1 update from 172.30.2.1 on Serial0/0/0
     172.30.1.0 in 1 hops
<output omitted>
R2#undebug all
All possible debugging has been turned off
R2#show ip route
<output omitted>

Gateway of last resort is not set

     172.30.0.0/24 is subnetted, 3 subnets
R       172.30.1.0 [120/1] via 172.30.2.1, 00:00:18, Serial0/0/0
C       172.30.2.0 is directly connected, Serial0/0/0
C       172.30.3.0 is directly connected, FastEthernet0/0
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
R    192.168.5.0/24 [120/1] via 192.168.4.10, 00:00:16, Serial0/0/1
```

Automatic Summarization

- **Sending RIP Updates**
  - RIP uses automatic summarization to reduce the size of a routing table

```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       <remaining codes omitted>

Gateway of last resort is not set

     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.1.0 is directly connected, FastEthernet0/0
C       172.30.2.0 is directly connected, Serial0/0/0
R       172.30.3.0 [120/1] via 172.30.2.2, 00:00:17, Serial0/0/0
R    192.168.4.0/24 [120/1] via 172.30.2.2, 00:00:17, Serial0/0/0
R    192.168.5.0/24 [120/2] via 172.30.2.2, 00:00:17, Serial0/0/0
```

```
R2#debug ip rip
RIP protocol debugging is on
RIP: sending  v1 update to 255.255.255.255 via Serial0/0/0 (172.30.2.2)
RIP: build update entries
      network 172.30.3.0 metric 1
      network 192.168.4.0 metric 1
      network 192.168.5.0 metric 2
RIP: sending  v1 update to 255.255.255.255 via Serial0/0/1 (192.168.4.9)
RIP: build update entries
      network 172.30.0.0 metric 1
R2#undebug all
All possible debugging has been turned off
R2#
```

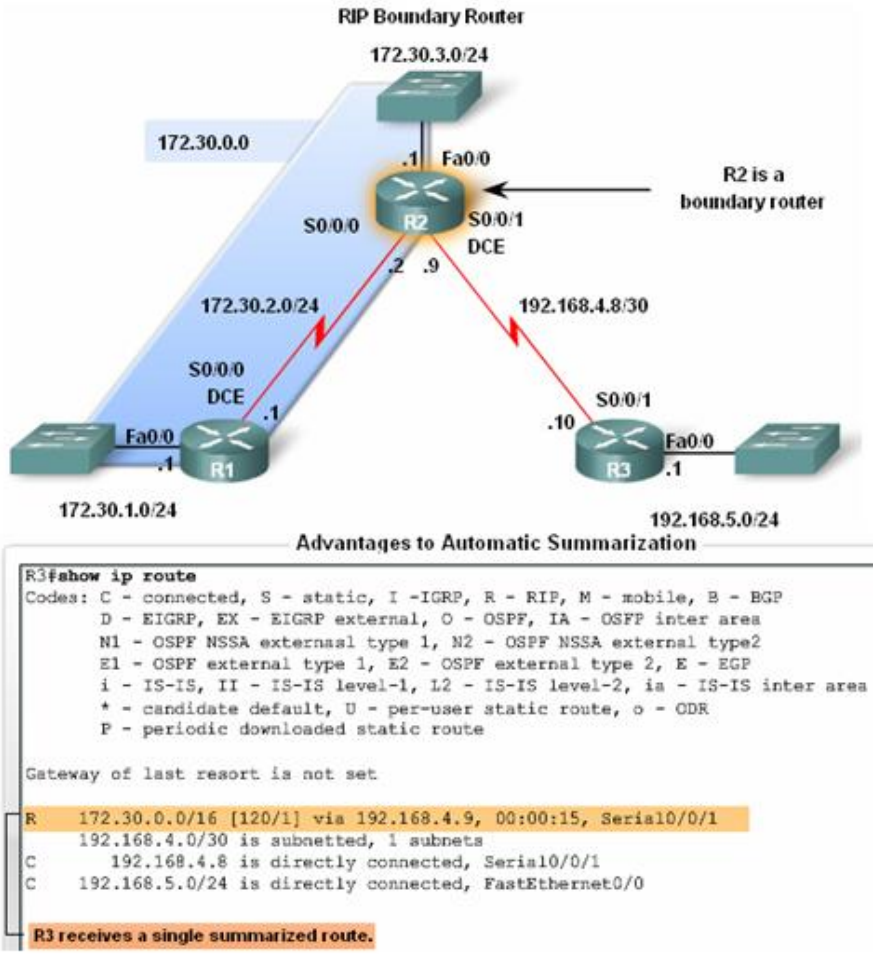
Routes sent to R1.

```
R3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       <remaining codes omitted>

Gateway of last resort is not set

R    172.30.0.0/16 [120/1] via 192.168.4.9, 00:00:15, Serial0/0/1
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
C    192.168.5.0/24 is directly connected, FastEthernet0/0
```

Compare R1 and R3 Routes for Network 172.30.0.0

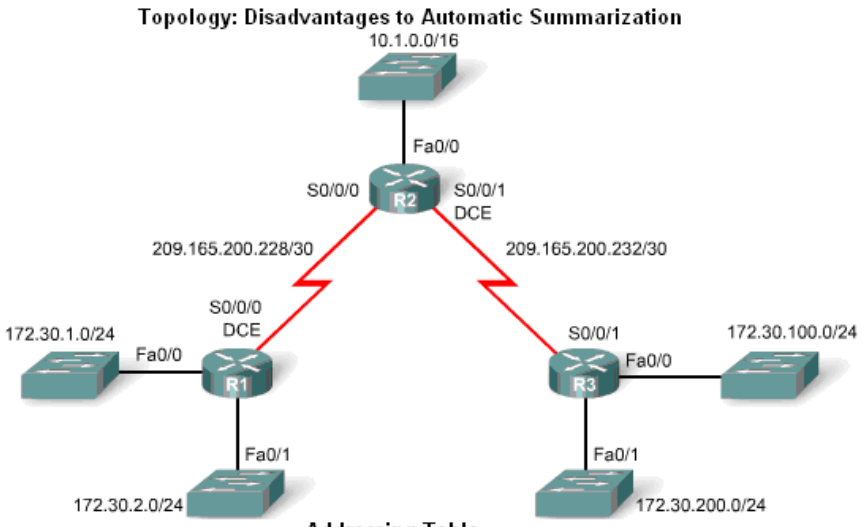
Automatic Summarization

- Advantages of automatic summarization:
  - The size of routing updates is reduced
  - Single routes are used to represent multiple routes which results in faster lookup in the routing table



Automatic Summarization

- Disadvantage of Automatic Summarization:
  - Does not support discontiguous networks

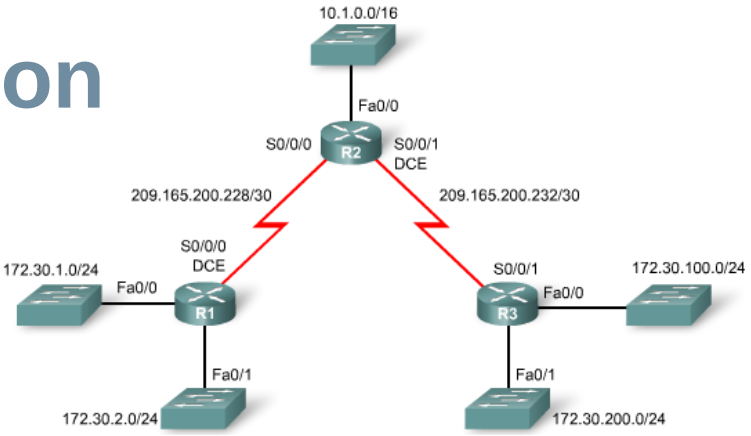


Addressing Table

Subnet Mask	Subnet Mask	Subnet Mask	Subnet Mask
R1	Fa0/0	172.30.1.1	255.255.255.0
	Fa0/1	172.30.2.1	255.255.255.0
	S0/0/0	209.165.200.229	255.255.255.252
R2	Fa0/0	10.1.0.1	255.255.255.0
	S0/0/0	209.165.200.230	255.255.255.252
	S0/0/1	209.165.200.233	255.255.255.252
R3	Fa0/0	172.30.100.1	255.255.255.0
	Fa0/0	172.30.200.1	255.255.255.0
	S0/0/1	209.165.200.234	255.255.255.252

Automatic Summarization

- Discontiguous Topologies do not converge with RIPv1
- A router will only advertise major network addresses out interfaces that do not belong to the advertised route




```
R1#show ip route
Gateway of last resort is not set

R    10.0.0.0/8 [120/1] via 209.165.200.230, 00:00:26, Serial0/0/0
     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.1.0 is directly connected, FastEthernet0/0
C       172.30.2.0 is directly connected, FastEthernet0/1
     209.165.200.0/30 is subnetted, 2 subnets
C       209.165.200.228 is directly connected, Serial0/0/0
R       209.165.200.232 [120/1] via 209.165.200.230, 00:00:26, Serial0/0/0
```

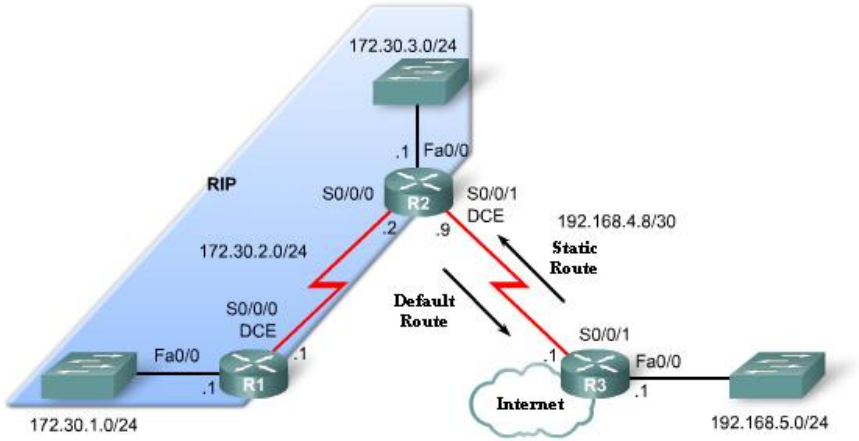
```
R2#show ip route
Gateway of last resort is not set

     10.0.0.0/16 is subnetted, 1 subnets
C       10.1.0.0 is directly connected, FastEthernet0/0
R    10.0.0.0/16 [120/1] via 209.165.200.234, 00:00:14, Serial0/0/1
                 [120/1] via 209.165.200.229, 00:00:19, Serial0/0/0
     209.165.200.0/30 is subnetted, 2 subnets
C       209.165.200.228 is directly connected, Serial0/0/0
C       209.165.200.232 is directly connected, Serial0/0/1
```

```
R3#show ip route
Gateway of last resort is not set

R    10.0.0.0/8 [120/1] via 209.165.200.233, 00:00:24, Serial0/0/1
     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.100.0 is directly connected, FastEthernet0/0
C       172.30.200.0 is directly connected, FastEthernet0/1
     209.165.200.0/30 is subnetted, 2 subnets
R       209.165.200.228 [120/1] via 209.165.200.233, 00:00:24, Serial0/0/1
C       209.165.200.232 is directly connected, Serial0/0/1
```

Default Route and RIPv1

- Modified Topology: Scenario C
- Default routes
  - Packets that are not defined specifically in a routing table will go to the specified interface for the default route
  - Example: Customer routers use default routes to connect to an ISP router
  - Command used to configure a default route is *ip route 0.0.0.0 0.0.0.0 s0/0/1*

Default Route and RIPv1



- **Disable RIP routing on R2 for the 192.168.4.0 network only.**
- **Configure R2 with a default route pointing to R3.**

```
R2(config)#router rip
R2(config-router)#no network 192.168.4.0
R2(config-router)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 serial 0/0/1
```

- **Completely disable RIP routing on R3.**
- **Configure R3 with a *static* route pointing R2.**

```
R3(config)#no router rip
R3(config)#ip route 172.30.0.0 255.255.252.0 serial 0/0/1
```

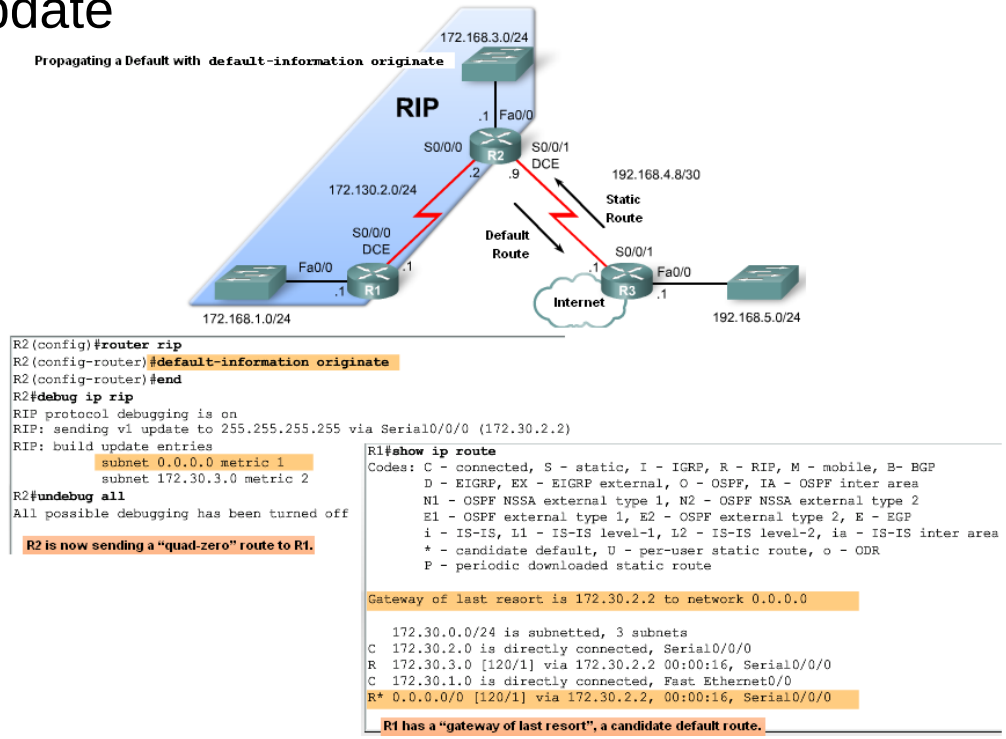
```
R1#show ip route
Gateway of last resort is not set

     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.1.0 is directly connected, FastEthernet0/0
C       172.30.2.0 is directly connected, Serial0/0/0
R       172.30.3.0 [120/1] via 172.30.2.2, 00:00:05, Serial0/0/0
```

```
R2#show ip route
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     172.30.0.0/24 is subnetted, 3 subnets
R       172.30.1.0 [120/1] via 172.30.2.1, 00:00:03, Serial0/0/0
C       172.30.2.0 is directly connected, Serial0/0/0
C       172.30.3.0 is directly connected, FastEthernet0/0
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
S*   0.0.0.0/0 is directly connected, Serial0/0/1
```

```
R3#show ip route
Gateway of last resort is not set

     172.30.0.0/22 is subnetted, 1 subnets
S       172.30.0.0 is directly connected, Serial0/0/1
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
C    192.168.5.0/24 is directly connected, FastEthernet0/0
```

Default Route and RIPv1

- Propagating the Default Route in RIPv1
- *Default-information originate* command
  - This command is used to specify that the router is to originate default information, by propagating the static default route in RIP update



Summary

- RIP characteristics include:
  - Classful, distance vector routing protocol
  - Metric is Hop Count
  - Does not support VLSM or discontiguous subnets
  - Updates every 30 seconds
- Rip messages are encapsulated in a UDP segment with source and destination ports of 520

Summary: Commands used by RIP

Command	Command's purpose
Rtr(config)#router rip	Enables RIP routing process
Rtr(config-router)#network	Associates a network with a RIP routing process
Rtr#debug ip rip	used to view real time RIP routing updates
Rtr(config-router)#passive-interface fa0/0	Prevent RIP updates from going out an interface
Rtr(config-router)#default-information originate	Used by RIP to propagate default routes
Rtr#show ip protocols	Used to display timers used by RIP